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TNO Human Factors
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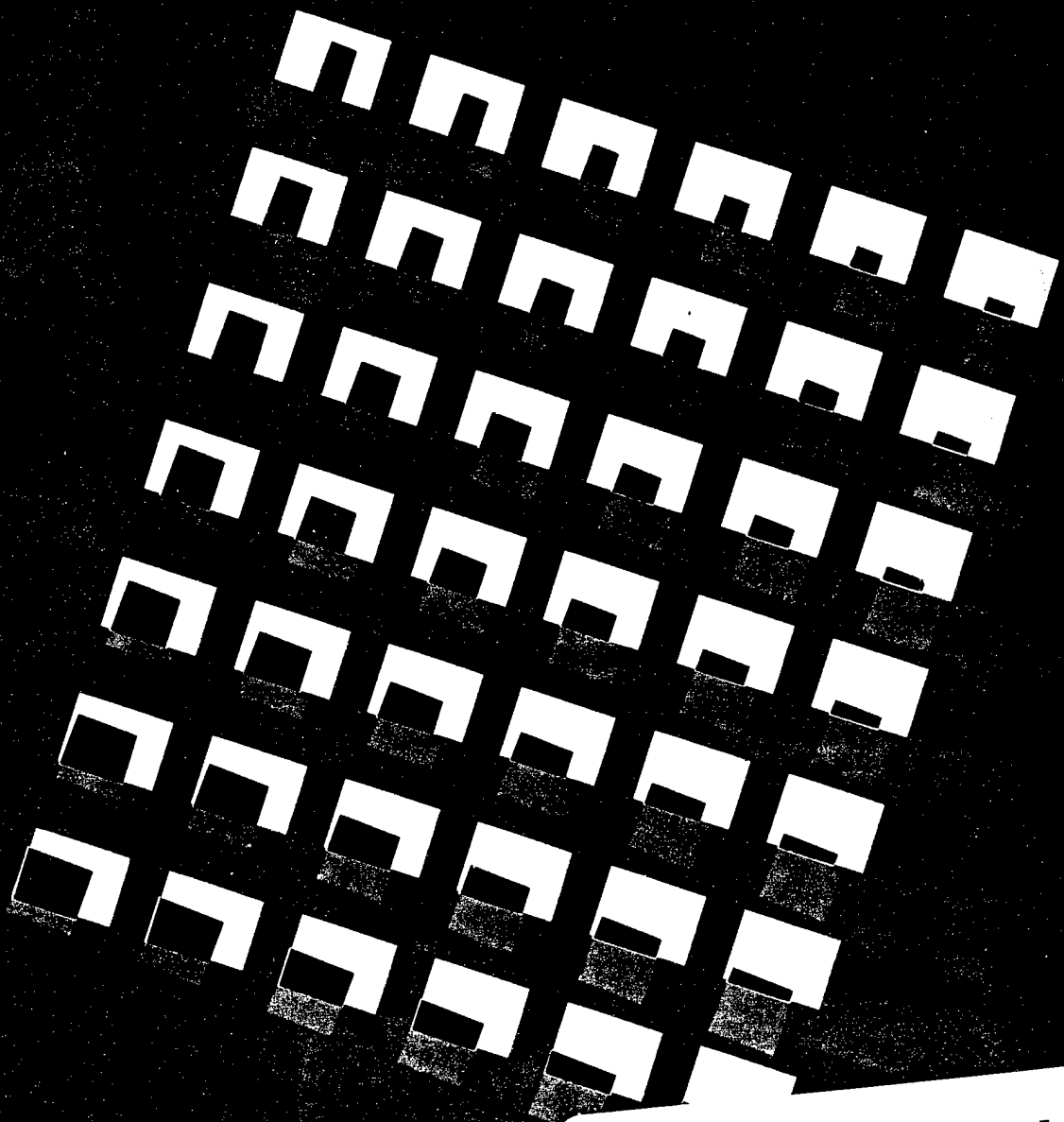
title

A proposal for research on a methodology for developing team training systems



TNO

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A proposal for research on a methodology for developing team training systems

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In zowel militaire als civiele organisaties worden veel taken eerder door teams dan door individuele functionarissen uitgevoerd. Ondanks het belang dat wordt gehecht aan team optreden worden relatief weinig systematische inspanningen geleverd met betrekking tot de training van teams. Een mogelijke verklaring hiervoor is dat er geen systematiek is die het ontwikkelen, uitvoeren en evalueren van team trainingen ondersteunt. De meeste systematieken en richtlijnen zijn primair gericht op het opleiden van de individuele functionaris. Het gevolg hiervan is dat opleidingsontwikkelaars van team trainingen beperkt ondersteund worden omdat de bestaande (op de individuele functionaris gerichte) systematieken onvoldoende de kenmerken van teams en team optreden verdisconteren. Dit heeft tot gevolg dat van bestaande leermiddelen die zijn ontworpen met als doel het trainen van team vaardigheden, het vaak niet duidelijk is welke onderwijskundige principes op welke manier toegepast moeten worden.
Team training wordt soms ten onrechte verward met team building of coöperatief leren. Hoewel er overeenkomsten zijn, zijn er ook duidelijke verschillen. Een belangrijk onderscheid tussen team training en team building is, dat team building meestal niet gericht is op de specifieke taken die een team in een bepaalde context moet uitvoeren, terwijl team training hier wel expliciet aandacht aan besteedt: er worden dus hele andere kennis en vaardigheden behandeld. In coöperatieve (onderwijs)-leersituaties is eerder sprake van een groep van individuen, dan van een team: het leren is primair gericht op het verwerven van vaardigheden door het individu (bv. rekenen), en minder nadrukkelijk op het verwerven van 'sociale' vaardigheden om als groep beter te functioneren. Het leren gebeurt in de context van een groep omdat verondersteld wordt dat dit bevorderlijk is voor het eindresultaat.
De onderzoeksvraag van deze studie is uit welke richtlijnen een opleidingsontwikkelsystematiek voor team trainingen zou moeten bestaan. Om deze vraag te kunnen beantwoorden wordt de volgende strategie voorgesteld: uitvoeren van een literatuurstudie, uitvoeren van een veldstudie, ontwerpen van een prototype, uitvoeren van een expert-evaluatie, uitvoeren van diverse experimenten om het prototype te testen, en toepassen van de systematiek in een of meerdere praktijksituaties. Deze strategie wordt uitgebreid toegelicht. De resultaten van de literatuurstudie (Van Berlo, 1996a) en de veldstudie (Van Berlo, 1997b) worden kort besproken.

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De onderzoeksvraag van deze studie is uit welke richtlijnen een opleidingsontwikkelsystematiek voor team trainingen zou moeten bestaan. Om deze vraag te kunnen beantwoorden wordt de volgende strategie voorgesteld: uitvoeren van een literatuurstudie, uitvoeren van een veldstudie, ontwerpen van een prototype, uitvoeren van een expert-evaluatie, uitvoeren van diverse experimenten om het prototype te testen, en toepassen van de systematiek in een of meerdere praktijksituaties. Deze strategie wordt uitgebreid toegelicht. De resultaten van de literatuurstudie (Van Berlo, 1996a) en de veldstudie (Van Berlo, 1997b) worden kort besproken.

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SUMMARY

Despite the acknowledgment of the importance of team performance and team training, relatively few endeavours have been undertaken to actually train teams in a systematic way. A possible explanation could be that there is not yet a methodology to guide the instructional developers and trainers in designing, executing, and evaluating team training systems. The research question to be answered in this study is which guidelines should be included in a methodology supporting the systematic development of team training systems. In order to give an answer to this question the following strategy is proposed: conduct a literature study, conduct a field study, develop a prototype of the methodology, conduct an expert-evaluation, test the prototype in various experiments, and apply the methodology in real-life cases. This strategy is discussed extensively. The results of the literature study (Van Berlo, 1996a) and the field study (Van Berlo, 1997b) are briefly reviewed.

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TNO Technische Menskunde
Soesterberg

Een voorstel voor onderzoek naar een opleidingsontwikkelsystematiek voor team training

M.P.W. van Berlo

SAMENVATTING

Ondanks het belang dat wordt gehecht aan team optreden worden relatief weinig systematische inspanningen geleverd met betrekking tot de training van teams. Een mogelijke verklaring hiervoor is dat er geen systematiek is die het ontwikkelen, uitvoeren en evalueren van team trainingen ondersteunt. De onderzoeksvraag van deze studie is uit welke richtlijnen een opleidingsontwikkelsystematiek voor team trainingen zou moeten bestaan. Om deze vraag te kunnen beantwoorden wordt de volgende strategie voorgesteld: uitvoeren van een literatuurstudie, uitvoeren van een veldstudie, ontwerpen van een prototype, uitvoeren van een expert-evaluatie, uitvoeren van diverse experimenten om het prototype te testen, en het toepassen van de systematiek in een of meerdere praktijksituaties. Deze strategie wordt uitgebreid toegelicht. De resultaten van de literatuurstudie (Van Berlo, 1996a) en de veld-studie (Van Berlo, 1997b) worden kort besproken.

1 BACKGROUND

Technological developments have resulted in more sophisticated and complex systems in which humans have to operate. These systems are characterized by a highly dynamic and sometimes hostile environment, the variation of (often conflicting) goals, the incompleteness, uncertainty and ambiguity of information, and the involvement of teams of officers with members having different roles and responsibilities (Rouse, Cannon-Bowers & Salas, 1992). Many tasks can not be performed by just one operator, but need to be accomplished by a team of several operators. A team is defined as a group of two or more people, with a common goal, a specific role assignment, and tasks/activities that are interdependent (Dyer, 1984). A team makes decisions in the context of a larger task, team members have specialized knowledge and skills relevant to the task and decisions, and the task conditions under which the team operates often include high workload and time-pressure (Orasanu & Salas, 1993; Salas, Bowers & Cannon-Bowers, 1995).

In both military and civil organizations many tasks are performed by teams rather than individual officers. A fire-brigade, a surgical team, a tank platoon, and a Stinger group are examples of such teams. Despite the acknowledgment of the importance of team performance and team training, relatively few endeavours have been undertaken to train teams in a systematic way. Team training is rarely being conducted as a separate training (except bridge and crew resource management) with the argument that functioning as a team can best be learned in the operational environment, and after each member is being trained for the individual tasks. Accident reports show that this 'on-the-job team training' does not seem to be the most effective and efficient way of preparing the team for its mission and tasks (Salas, Cannon-Bowers & Johnston, 1995). This process could be enhanced by carefully developed team training systems.

A major obstacle in the process of developing team training systems is that most methodologies and guidelines for developing training systems are aimed at the individual trainee (Armstrong & Reigeluth, 1991). A coherent methodology for developing team training systems is still lacking (Miller, Guerette & Morgan, 1987; Guerette et al., 1987). Consequently, developers of team training systems must often resort to the use of recommendations and guidelines geared to the development of individual-centered training systems. However, these may be insufficient given the different nature and characteristics of teams and team performance. Related to this point is the fact that most instructional devices are developed for training individual officer's skills. Regarding complex learning environments developed for team training, e.g. SIMNET (Alluisi, 1991) and CATT (Combined Arms Tactical Trainer), it is often not clear which, and how, instructional principles should be applied to train the team (Salas & Cannon-Bowers, in press).

In many cases, the to be trained team is presented with instruction and feedback at an ad-hoc basis, leaving the content and timing of instruction and feedback to the initiative of the instructor (Guerette et al., 1987). Consequently, instructors devote much time and effort in

on-line determining the most effective way of presenting information and measuring the team performance, and the most adequate way of providing feedback. This process could be more effective and efficient if a more formal and systematic methodology for developing and monitoring team training would be available (Miller, Guerette & Morgan, 1987).

More than fifteen years ago several authors have indicated the need for a systematic development of team training (Kribs, Thurmond & Marks, 1977; Rizzo, 1980; Thurmond, 1980). The development of team training systems is a complex and costly enterprise. A methodology for systematically developing team training could help to reduce these costs. It can eliminate unnecessary or ineffective, but costly, training practices that do not contribute to the learning of team skills. Furthermore, the costs associated with poor team performance in operational environments due to inadequate training, are probably very high.

Team training is often confused with the concepts 'team building' and 'cooperative learning': in chapter 2 the field of team training research will be defined. In chapter 3 the research question of this study is delineated. The proposed strategy to follow in order to answer the research question, is presented in chapter 4. This is followed by a discussion of the literature study (chapter 5) and the field study (chapter 6).

2 DEFINING THE FIELD OF RESEARCH

Many factors have an influence on the effectiveness of teams, like, amongst other things, the number of team members, the allocation of tasks within a team, the way personnel is rewarded, the role of the team commander, the way the team is embedded in the organization, the selection of adequate team members, team building activities, and team training. This research focuses on team training. The concept 'team training' is, however, often confused with the concept 'team building'. Although the ultimate goal of both team training and team building is the same (i.e. improving team performance), there are some considerable differences between the two. Also, 'team training' is sometimes wrongly conceived of as 'cooperative learning'. Again, there are similarities, but distinctions as well. In this chapter the differences and relationships between team training on the one hand, and team building and cooperative learning on the other hand, are discussed, with the purpose to define the field of research described here (Van Berlo, 1997a).

Training the members of a team can be primarily aimed at skills required for adequate team task performance, or at social skills required for functioning as a group (taskwork vs teamwork: Morgan et al., 1986; Glickman et al., 1987). 'Team training' is focusing on the taskwork, while 'team building' has its focus on teamwork. Team building is not specifically aimed at tasks a team has to perform in the operational task environment, while, on the other hand, team training explicitly focuses on these tasks.

Both team training and team building are kinds of training a team, but each type is aiming at different knowledge and skills required for adequate team performance.
'Training' is a systematic enterprise to enable the trainees to acquire the knowledge, skills and attitudes required for adequate task performance. Based on instructional objectives the contents and structure of the training is determined in such a way that these objectives will be met. 'Team building', however, is more like a set of activities with the intention to give (groups of) individuals a deeper understanding of their behaviour and their interpersonal relationships. Although a general framework can be formulated in advance, in most cases the specific content of the team building intervention is more dependent on discussions, between trainees and with the trainer, during the intervention.
A final distinction between team building and team training is that team building activities are always performed with the persons comprising the actual team: in view of the general goal of team building it would be undesirable to involve other persons into this effort. Team training does not necessarily need to be conducted with the actual team members: every team member gets a training aimed at the own role and the own tasks within the team (independent of who will be the other team members), so it is not a disadvantage per se that other persons play the roles of other team members.

A cooperative learning situation resembles daily practice in which persons work together with other persons. But learning in groups is not the same as team training. In cooperative learning situations it are individuals that learn together, rather than a team (see chapter 1). In accordance with the cooperative learning perspective, learning in groups benefits the acquisition of knowledge and skills by the individual trainee (e.g. arithmetic), and, as a side effect, the acquisition of 'social' skills as well (e.g. collaborating with each other). In fact, trainees are examined individually in order to assess whether they have acquired these individual knowledge and skills. The focus is on individuals, and the learning takes place in a group for didactical purposes. The acquisition of social, interpersonal skills rather seems a secondary effect of this kind of instruction, and has not been systematically demonstrated (Erkens, 1997).

3 RESEARCH QUESTION

The objective of any training system is to change the competencies of the trainees so they can perform their tasks in the operational environment effectively and efficiently. The task, the context in which it has to be accomplished, and the required skills make up the conditions for the instructional systems development process. A description of the task that has to be learned, and the way in which this will be implemented in a training program, is the output of several consecutive steps. These steps can be subsumed under the headings of analysis, design, implementation, and evaluation. Exactly how to follow the distinct steps that comprise these phases, is depicted in guidelines. Developing team training systems could include the same phases of development: tasks as well as the requisite knowledge, skills and attitudes

have to be analysed; instruction, practice and training devices have to be designed; the training system has to be field tested; the training system must provide for assessment of the trainees, and the training system must be evaluated itself. However, the guidelines to follow the steps could be somewhat different. For instance, analysing a team task probably poses different demands than analysing an individual task. Also, designing scenarios for instruction and practice of the team is somewhat more complicated than scenario design for individual trainees. Team training devices have other requirements (e.g. communication processes) than training devices for individual trainees. Further, assessing the team's performance is more complex.

A team training methodology should be a coherent set of guidelines, based on principles of learning and training, for developing, designing and delivering instruction to enhance and maintain team performance in the operational task environment. It should involve creating a learning environment in which the team members can acquire and practice the necessary knowledge, skills and attitudes required for adequate team performance. Adequate diagnosing, assessing and remediating the team's performance should be essential features of a training system to be effective (Salas & Cannon-Bowers, in press).

Given the need for, and the demands made upon a methodology for developing team training systems, the basic research question to be answered in this project is:

Which guidelines should be included in a methodology supporting the systematic development of team training systems?

In answering this question insight needs to be gained into several topics:

- what is described in the literature about the design and development of team training?
- how is team training being designed and developed within the military?
- what requirements should advanced training devices meet in optimizing team training?
- how should training of individual operators and team training be harmonized?
- how does the development of shared mental models affect team training (Schaafstal & Bots, 1997)?

4 STRATEGY

In this chapter the proposed strategy to follow, in order to answer the research question, is presented. The proposed strategy consists of 11 consecutive steps, each representing a distinct phase in the research project.

Step 1: Conduct a literature study. See chapter 5 for the results of the literature study.

Step 2: Conduct a field study.

a Conduct interviews with staff members of military training centres where the training developers and trainers themselves are being trained.

b Conduct interviews with the training developers and trainers of the military training centres.

c Conduct interviews with training practitioners in civil organizations.

d Attend/observe team training programs. If there would be few possibilities to do this in the Netherlands, the field study will be extended to the USA (e.g. National Training Centre, Fort Knox, Naval Air Warfare Center).

e Review the reports of visits other colleagues have made to several military training centres.

The field study is described in more detail in chapter 6.

Step 3: Integrate the results of both literature and field study, and develop a (paper-based) prototype of a methodology for developing team training systems. This prototype methodology has to contain guidelines as concrete as possible.

Step 4: Conduct a first expert-evaluation of the prototype. Experts could be from the military, from TNO-HFRI, or from external organizations (civil, universities). Possible methods for this evaluations can be: interview, evaluation checklist, group discussion, Delphi, or combinations of these methods. No decision has been made regarding the implementation of this step yet.

Step 5: Test the prototype of the methodology in various experiments.

Experiment 1:

Goal: The purpose of the first experiment is to use the subjects as co-constructors of the methodology: because they are experts, they will probably have valuable comments on the prototype. The following approach is suggested:

Subjects: The subjects are working in civil organizations and must have at least four to five years of experience as instructional designers. The advantage of using experts is that they can give useful comments concerning the usability of the methodology. The risk of using military subjects is the variability in level of experience and expertise: usually an officer holds a position for only three years. Using the comments and remarks of the expert-subjects will benefit the construction of a more advanced prototype of the methodology.

Task and materials: The subjects are asked to (individually) develop a blueprint of a team training program based on the guidelines of the prototype. The team task being used is TANDEM[1]: TActical Navy DEcision Making task, developed by and obtained from the Naval Training Systems Center (Florida). The advantage of this laboratory team task is that subject-matter knowledge is being controlled for.

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[1] Provided that TANDEM is a really complex team task, and the team members should acquire considerable specific knowledge and skills for an adequate task performance. If not, another experimental team task has to be developed (e.g. a modification of Space Fortress).

Procedure: The subjects receive documentation explaining the TANDEM-task, and a (brief) demonstration of this team task. Next, the subjects have about 2½ hours to design a blueprint of a TANDEM-training program. They have to think aloud, and are allowed to make notes. In this way a baseline measurement can be performed. After the subjects have designed a training program, the prototype of the methodology is discussed. This discussion is initiated by using a walk-through procedure, in which the researcher guides the subjects through the (paper-based) methodology. During this phase, the researcher asks questions regarding the meaning and interpretation of several concepts, steps and guidelines. Based on the subjects' experiences of the experimental task, they are expected to give feedback and comments on the prototype of the methodology.

Experiment 2:

Goal: The purpose of the second experiment is to determine to what extent subjects have a corresponding interpretation of the prototype: do subjects interpret the distinct steps in a similar way (reliability)? The following approach is suggested:

Subjects: In this experiment the subjects are military instructional designers with about two to three years of experience. In this step the target group (the military) will use the methodology.

Task and materials: The subjects are asked to (individually) develop a blueprint of a team training program based on the guidelines of the prototype. The team task being used is TANDEM: TActical Navy DEcision Making task, developed by and obtained from the Naval Training Systems Center (Florida). The advantage of this laboratory team task is that subjects' subject-matter knowledge is being controlled for.

Procedure: The subjects receive instruction regarding the prototype-methodology. This instruction is provided using a walk-through procedure, in which the researcher guides the subject through the (paper-based) methodology. During this phase, the researcher asks questions regarding the meaning and interpretation of several concepts, steps and guidelines. Subjects receive documentation explaining the TANDEM-task, and a (brief) demonstration of this team task. The subjects have about 2½ hours to design a blueprint of a TANDEM-training program. They have to think aloud, and are allowed to make notes. The think-aloud protocols will be analysed (Perez, Fleming Johnson & Emery, 1995). After the session the subjects are asked to complete an evaluation form.

Experiment 3:

Goal: The purpose of the third experiment is to determine the effect of the methodology in an experimental setting. The following approach is suggested:

Subjects: In this experiment the subjects are 'Educational science' students. They do not have broad experience and expertise in developing instruction, but understand the relevant basic knowledge and skills.

Task and materials: The subjects are asked to (individually) develop blueprints of two team training programs. The first team task being used is TANDEM, the second team task is a modified version of Space Fortress.

Procedure: The subject are divided into two groups. The first group is asked to develop a blueprint of a TANDEM training program, without the support of the methodology. After the development of the blueprint, the subjects receive instruction in the methodology. After this instruction the group must develop a Space Fortress training program. The second group follows the same procedure, but first develops a blueprint of a Space Fortress training program, followed by a blueprint of a TANDEM training program. In this way for both team tasks the effect of the methodology on the quality of the blueprints can be measured.

Step 6: Modify, if necessary, the prototype-methodology based on the results of the experiments.

Step 7: Select a real-life case[2]. The goal of the case study is to test the prototype-methodology in a field setting. The case should meet the following requirements:

a the training centre is willing to alter, if necessary, their way of developing and executing (team) training programs

b the team training program is performed on a regular basis. This will provide a reference point.

c it should be possible, from a research perspective, to gain insight in process and product variables relating to instructional system development (see step 9). This insight will be obtained from studying relevant documents and by interviewing the instructional designer(s) and trainer(s). The information has to be assessed using predefined criteria that must be identical to the criteria used in the evaluation of the 'new' team training program; if this information is hard to obtain, a review of the current ISD-process conform step 9 should be considered. In this way both a pre- and a post measurement can be realized (One-Group Pretest - Posttest Design, see: Cook & Campbell, 1979).

Step 8: Give instruction/training to the developers to make sure the methodology will be used in a proper way. Construct a manual and/or provide computer-based support.

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[2] If steps 7 through 9 are too difficult to arrange practically or too time-consuming, the use of an experimental environment should be considered.

Step 9: Determine the quality of the new methodology based on the experiences obtained during the case study. The quality can be determined on two dimensions: process and product.

I - PROCESS:

Variables

a the way intermediate products have been produced
b the total time devoted to the development process
c aspects on which the methodology is not sufficient
d aspects on which the methodology is sufficient

Methods

a frequently interviewing the instructional developers (and trainers)
b attend the meetings between developers (and trainers)
c let the developers keep a 'log-book' in which they write down their experiences. This logbook could be integrated in a computer-based software tool supporting the methodology.

II - PRODUCT:

Variables

a the results of the analyses
b the quality of the intermediate products
c the quality of the final result (the training program)
d suggested changes/modifications of the methodology
e the students' results
f the total training time

Methods

a let trainers complete a questionnaire (possibly with additional interviews)
b let students complete a questionnaire (possibly with additional interviews)
c assess the intermediate and final documents (results of analyses, instructional objectives, blueprint of the program, training scenarios) by independent (external) reviewers. A checklist has to be developed, as well as the criteria.
d implement the team training and measure the performance of the students/team.

The results of the new approach can be compared with the results of the traditional approach. In this way a measurement of the effect of the new methodology can be established.

Step 10: Modify, if necessary, the prototype-methodology based on the results of the case study.

Step 11: Select a new case, and follow steps 8 through 10 again.
The aim is to develop a methodology as general (and useful) as possible, suited for a wide range of teams and team tasks. This could be achieved by conducting several case studies. Striving for generalizability is also achieved by conducting a rather broad literature and field study.

5 LITERATURE STUDY

A literature study has been conducted in order to analyse to what extent guidelines are available that specifically address the development of team training systems. In this chapter, the literature study is briefly discussed: for a more detailed description and evaluation of the guidelines, and discussion of the results, see Van Berlo (1996a).

Developing instructional systems roughly consists of four distinct phases: analysis, design, implementation, and evaluation. With regard to team training, the analysis phase is partly described by the MAP system (Levine et al., 1988), and the TEAM model (Morgan et al., 1986; Salas, Morgan & Glickman, 1987). The *Multiphase Analysis of Performance (MAP) system* consists of a taxonomy for team training. First, the instruction can be aimed at the individual team member or at the team as a whole. Next, both individual and team can be either experienced or inexperienced. Finally, training can be directed towards interpersonal skills or production skills. Combining these levels results in an eight-cell job analysis taxonomy for team training (Levine et al., 1988; Levine & Baker, 1991). For each cell, the authors have indicated the descriptors which characterize the team task, the sources of data that can be regarded, the most adequate methods of data collection, and the methods of data analysis.
The *Team Evolution and Maturation (TEAM) model* is based on the assumption that a team passes through several phases in becoming a proficient team (Morgan et al., 1986; Salas, Morgan & Glickman, 1987). As the training progresses the team learns more about the operational team task itself, the demands posed by the task environment, the abilities and characteristics of the other team members, and about working, coordinating, and communicating collectively. This process, the maturation from an unskilled and immature team towards a skilful and mature team, has been classified into nine phases. In the TEAM model a specific distinction is made between taskwork and teamwork. To attain an optimum effect of the team training it is assumed that both taskwork and teamwork should first be trained separately. Gradually these skills should be trained more integrated, so eventually both skills can be applied in performing the team task.

The phases of both analysis and design are described by the TIP theory (Armstrong & Reigeluth, 1991) and by the propositions for team training by Cannon-Bowers et al. (1995b). The *Team Instructional Prescriptions (TIP) theory* (Armstrong & Reigeluth, 1991) contains four elements: the desired output, the conditions, the instructional methods, and a set of

guidelines in which output, conditions and methods are being integrated. The result of team training is twofold: it is directed at both teamwork and the team task (Salas, Morgan & Glickman, 1987). The conditions influencing team training are comprised of three types of variables: the team development phases (Morgan et al., 1986), the task dimensions (interdependent vs independent tasks, and procedural vs transfer tasks) and the relationships between tasks (superordinate, coordinate, subordinate). The instructional methods are discussed at three levels of strategy: macro, mid-level, and micro strategies. Result, conditions and instructional methods are integrated into a coherent set of prescriptive guidelines. The TIP theory contains three models, each representing a team development phase. Each model consists of a combination of task relationships and the task dimensions. Each model embraces the instruction and practice regarding the role the individual team member has within the team: the more the team matures, this role-instruction and practice will be more specific.

Cannon-Bowers et al. (1995b) presented a framework providing four types of team competencies based on situational and task characteristics (context-driven, team-contingent, task-contingent, transportable). Based upon this framework the authors offer sixteen *propositions* regarding the nature of team training required for developing specific competencies in teams and regarding the most successful strategies. The propositions fall into two related categories: those that involve the manner in which the task and situational (i.e. environmental) characteristics influence the nature of the team's competency requirements, and those that link the categorization of team competencies to training requirements and strategies.

Guidelines for developing training scenarios during the design phase are presented by Prince et al. (1993) and Schank et al. (1993/1994). Based on existing guidelines (Federal Aviation Administration, 1990; Lauber & Foushee, 1981) and practical training experience, Prince et al. (1993) presented guidelines for simulator scenario development with respect to crew resource management behaviour training. The guidelines are separated into five categories: scenario overview, objectives, realism, role of the facilitator, and technical tips.

Schank and his co-workers (1993/1994) focus on so-called Goal-Based Scenarios that can be performed by the trainees in a computer-based learning-by-doing environment. A Goal-Based Scenario (GBS) is defined as such to emphasize that a training scenario should be task-oriented, with clearly specified objectives. Schank et al. (1993/1994, p. 322/3) identify seven general criteria that a GBS design should meet: thematic coherence, realism/richness, control/empowerment, challenge consistency, responsiveness, pedagogical goal support, and pedagogical goal resources. A GBS consists of several components that should be identified successively: mission, mission focus, cover story, and scenario.

The phases of design and implementation are partially described by the TIPM model (Guerette et al., 1987; Miller, Guerette & Morgan, 1987), and the Teamwork and Instructional Characteristics Checklists (Swezey, Llaneras & Salas, 1992). The checklists also partly describe the evaluation phase. Based on the experiences with the previously described TEAM model, the *Team Instructional Processes Model (TIPM)* has been developed (Guerette et al.,

1987; Miller, Guerette & Morgan, 1987). The team development phases as described by Morgan et al. (1987) are linked with specific training strategies. The TIPM contains ten steps: (1) pretraining capability assessment, (2) preliminary assessment of needs, (3) determination of training approach, (4) information presentation, (5) mission performance, (6) evaluation and debrief, (7, 8 and 9) more specific training (cm steps 3, 4 and 5), and (10) evaluation and joint debrief.

Swezey, Llaneras and Salas (1992) constructed two checklists supporting the organization and presentation of guidelines regarding the development and evaluation of team training systems: the *Teamwork Characteristics checklist* (30 items) and the *Instructional Characteristics checklist* (41 items). The first step in using each checklist is, for each item on the list, to indicate whether the training program includes the respective (teamwork or instructional) characteristic. This step is followed by scoring the importance of each characteristic on a 5-point rating scale (0 = not important; 4 = extremely important), regardless of the result of the first step. By combining these two results, shortfalls in the training system can be easily identified.

Given the definition of a team training methodology, the four general phases of instructional systems development, and the state-of-the-art as described in the literature, an inventory can be made up of the missing knowledge in producing an integrated methodology for developing team training systems.

First of all, it is important that the performance deficiencies of a team are identified. Such a tool for conducting a performance analysis is still lacking (Salas & Cannon-Bowers, in press). Based upon these performance deficiencies, the training needs of the team must be analysed (Salas, Bowers & Cannon-Bowers, 1995) and a selection of the to-be-trained tasks has to be made (Bowers, Baker & Salas, 1994). Finally, a tool has to be developed by which the task demands and the training needs could be linked with specific training strategies, including proper performance assessment methods and strategies for remediation (Salas, Bowers & Cannon-Bowers, 1995).

There still is not a connection node between the way a team matures, and how the training system should correspond with this process (Salas & Cannon-Bowers, in press). Procedures and tools for optimizing training strategies based on key team variables should be developed (Guerette et al., 1987). Not just the process remains unclear; the way in which the training system should take into account the input variables (e.g. characteristics of the trainees and the environment) remains unclear as well. A pre-training diagnostic instrument to assess the team's abilities needs to be developed (Guerette et al., 1987). More specifically, gaining insight into the relationship between team attitudes (e.g. team cohesiveness) and team performance can benefit the training of teams (Salas, Bowers & Cannon-Bowers, 1995). The same holds true for the impact of the organizational context on the training system. The required output of a team training system (e.g. what constitutes a good team performance) needs to be defined in a more complete way (Cannon-Bowers et al., 1995a; Armstrong & Reigeluth, 1991; Salas, Morgan & Glickman, 1987; Miller et al., 1987; Guerette et al., 1987).

A methodology for developing team training systems should be based on principles of learning and training. Ascertaining which principles are prevailing, and how these principles should be applied in team training systems, is a major research question (Salas & Cannon-Bowers, in press).
Complex, technologically advanced learning environments are being developed for team training. As already indicated, it is often not clear which, and how, instructional principles should be applied to team training systems. The application of new, advanced technologies like multi media, intelligent tutoring systems, teleconferencing, and distributed interactive simulation should be studied in a more profound way.

Guidelines for designing training scenarios are almost non-existent. Two sets of guidelines have been identified (Prince et al., 1993; Schank et al., 1993/1994) both comprising valuable components. An integrated set of guidelines for designing scenarios, encompassing the entire process of scenario development, is still lacking.

Checking whether the training system is effective is a very important phase in training. Due to the fact that measuring the results of team training is more complicated than it is for training individual operators, this activity usually is not performed in an objective and accurate manner (Salas, Bowers & Cannon-Bowers, 1995; Salas, Morgan & Glickman, 1987; Guerette et al., 1987). Feedback is provided at the level of the individual trainee, rather than including the team aspects of the performance. Besides, feedback related to both the taskwork and teamwork (see the TEAM model: Morgan et al., 1986; Salas, Morgan & Glickman, 1987) should be presented to the team members (Guerette et al., 1987). Training assessment procedures for collecting team performance measurement data should be developed. Given that technological advanced learning environments are developed, the possibility of automatic team performance measurement (i.e. both collection and interpretation) is worthwhile to be explored (Salas & Cannon-Bowers, in press; Guerette et al., 1987).

The cost-effectiveness of a training system is being neglected in many cases. However, in times of decreasing budgets, detailed information on the costs of training and instruction must be made available to ensure cost effective training. This is especially the case when training devices are used that are relatively expensive to design and produce, such as software packages and simulators (Van Berlo, 1996b). A problem in estimating the cost effectiveness of a training system is the difficulty of clearly defining the precise effects or benefits; e.g. it is impossible to transform these in monetary value only (Blomberg, 1989). Cost-effectiveness analysis regarding the development of team training systems is a largely unknown domain.

The guidelines previously discussed differ in comprehensiveness. Many aspects regarding the development of team training are being included (Salas, Cannon-Bowers & Blickensderfer, 1995), but a coherent set of guidelines is still missing. Also, the available guidelines are not exhaustive. Therefore, a consistent methodology for developing team training systems has to be developed, containing prescriptive guidelines for both instructional developers and instructors.

Finally, most of the guidelines and methodologies have not been tested empirically (Salas, Bowers & Cannon-Bowers, 1995), although this occurs more and more (e.g. Brannick et al., 1995; Bowers, Baker & Salas, 1994; Fowlkes et al., 1994). Yet, this point of critique applies equally to training systems directed at individual trainees (e.g. Gustafson, 1991; Andrews & Goodson, 1980).

6 FIELD STUDY

Besides what is described in the literature, another source of information is the current practice of designing, developing and executing team training. In this chapter, a field study is briefly described. For a more detailed discussion, see Van Berlo (1997b).

The primary research method in this field study is to conduct interviews with those persons responsible for designing and executing team training. Other sources of information (Yin, 1984) are documents/archival records (e.g. reports of interviews and visits of colleagues), observation[3] (e.g. attending team training programmes), and physical artifacts (e.g. training simulators). For practical reasons, only Dutch facilities have been visited.
Given the goal of the field study, the training developers and the trainers are appropriate persons to be interviewed. The following categories of interview questions have been developed: background information, organization and premises, analysis, design and execution, performance measurement and feedback, instructional methods and training devices, evaluation and maintenance, and concluding remarks. At the beginning of the interview a short explanation defining the goal of the interview and the purpose of the research project was presented. The questions were not always asked literally, but served as a structure to guide the interview. A detailed overview of all questions is included in the Appendix.
In order to get a broad picture of the way team training is being designed and executed, both military and civil organizations are included in this field study. The primary focus, however, is on the military practices. Interviews were conducted with persons of the Royal Netherlands Air force, the Royal Netherlands Navy, the Royal Netherlands Army, and the Royal Military Police. Due to the fact that many different military organizations were willing to participate, only one civil organization could be included in the field study.

Twelve interviews have been conducted from November 1996 till May 1997. The field study shows that there are many activities in the field of team training. The general picture,

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[3] It is planned to select one or more training centres in order to attend and observe team training programmes. This step is an essential step, because the actual training practise could be somewhat different from the designer's and trainer's intentions (expressed in the interviews). To get a clear picture of a team training programme, observations will last for at least several days during a longer period of time (depending on the total length of the training programme). Ideally, the trained team should also be observed during a field exercise in the operational environment.

emerging from the field study, shows that these activities are not always very systematically organized. The discussion of the results is structured around the categories of the interview questions: background information, organization and premises, analysis, design and execution, performance-measurement and feedback, instructional methods and training devices, and evaluation and maintenance.

Background information

The interviewed persons have different jobs/assignments in the field of team training, varying from commander of a training section, to instructional developer, trainer, and consultant. A wide variety of teams are being trained at the training centres, like tank platoons, infantry units, ground-to-air defence crews, cockpit crews, fire fighting and damage control units of a frigate, military police units, and air-mobile crews.

Organization and premises

No standard methodology for developing team training systems is being used. In most cases an existing methodology for developing training aimed at the individual operator, is used. Although the main phases (analysis, design, development, implementation, evaluation) are the same, the interviews show that the specific steps comprising the phases, appear to be quite different. Especially conducting an analysis of team tasks, designing training scenarios for teams, and assessing the performance of the team, are steps that require teamtraining-specific knowledge.
During the process of developing team training systems, in most cases hardly any information is systematically being stored. The way of gathering information, making decisions about the contents and structure of training programmes, and executing and assessing the training programme, is therefore largely determined by an individual instructional developer. This has the risk in it that most knowledge and skill will disappear with the reallocation of this officer. This means that there is no opportunity to build a knowledge base within the organization, promoting the re-use of information and expertise, and a critical reflection on the process of developing team training systems. Furthermore, using a standard methodology, and re-using information enhances the efficiency of training development.

Analysis

No explicit analyses of team tasks are conducted. The tasks of individual operators are analysed, sometimes taking into account the specific skills for operating in a team. Usually management documents, depicting combat instructions of (larger) teams, are used to analyse the team and the operational environment. But with respect to developing training, these documents are too general. Therefore, the instructional developer has to rely on his own operational practice in the particular field. A disadvantage of merely relying on this experience, is the fact that every expert has his own subjective experience, depending on the situations in which he performed his tasks. This experience does not necessarily has to be

representative for other experts as well. There is hardly an objective, agreed-upon base for developing team training programmes.
Another problem of merely using the developer's operational experience rises in the case of new kinds of teams. These newly formed teams do not have yet performed any missions, so there are no experts in the field. Deciding what to train, and which performance measures should be taken into account, is not possible on the basis of existing operational expertise.

Design and execution

There are no guidelines to support the design of training scenarios. For both live (field) exercises and simulator training sessions the instructional developers indicate a need for support. Designing a scenario that is adequate for all trainees, taking into account all relevant practical constraints (like personnel, time, available terrain, the specific training device) is of paramount importance for training effectiveness.
Besides the effectiveness, the efficiency of training design and execution can be improved. An example of a team training strategy that has been applied is that all team members simply receive training in all different individual tasks, so everyone should be able to perform effectively in every position in the team. In another case the student-commanders play the roles of the other team members. These examples look like, but are not the same as, crosstraining. Crosstraining means that team members receive training in their own tasks, but also receive additional training in other team members' tasks. In the previous example, however, no formal instruction is given and the trainees merely act as other team members for training the student that actually plays the role of the commander at that time. Also, at the respective training centres all team members received training relevant to all tasks of all team members. But the degree of crosstraining should be varied, depending on the interdependencies between the tasks of the particular team members. Applying the most adequate crosstraining strategy could take less time, without decreasing results (Schaafstal & Bots, 1997).

Performance measurement and feedback

In order to conclude whether a team (or a team member) has acquired the knowledge and skills required for operational team practice, the performance should be assessed. Therefore team performance measures are needed. These performance measures, however, have not yet been adequately developed. There are no strict criteria for assessing the team's performance in a more objective way. The consequence is that every trainer has considerable degrees of freedom in determining whether a training has been successfully followed, using his own operational experience as point of reference. This has the risk in it that the performance assessment can be biased.
Especially when training larger teams, the chief instructor is not able to monitor and assess the team's performance during the training. Therefore, assistant instructors (observers) are being deployed. The observers' deployment, however, could be more effective when appropriate support is provided. Clear instructions concerning their tasks, guidelines for

monitoring the trainees' performance, guidelines for providing feedback, and suitable job-aids could enhance the observers' effectiveness.

Instructional methods and training devices

In current learning environments (real life and simulated) it is not possible to train teams in all relevant skills. On the one hand the available exercise terrains are not sufficiently large to realistically conduct life exercises deploying larger teams. On the other hand the present training devices can not simulate all important operational environments and events. A related point is the fact that instructional features of a training simulator are often neglected in favour of the fidelity features (does the simulator resemble the real system in its real environment). Instructional features, like, for instance, performance measurement, freezing the scenario, play-back of (parts of) the scenario, and (automatically) providing feedback, are elements that facilitate learning by the team members. Both fidelity and instructional features should be important elements of a (simulated) learning environment. In most cases, however, instructional developers are not involved in defining the specifications of training simulators. Involving instructional developers in the process of specifying simulators could improve the effectiveness of these training devices.

Evaluation and maintenance

The effectiveness of training programmes is hardly measured. Some team building courses do have a kind of interview with the former trainees some time after the training. In other cases the training centres mail a questionnaire containing questions about, amongst others, the contents, structure and relevance of the training. A systematic and empirical study of the effects of a training programme is not conducted. This, however, is the ultimate check whether the training programme meets its goal (i.e. enhancing the team's effectiveness in the operational environment).
The feedback loop from operational practice to training programmes is, in general, not a systematic one. It remains too implicit and too much depends on coincidental contacts between persons. Only if severe flaws are found, or accidents occur, feedback is given to the training centre.

7 CONCLUSIONS

The results of the literature and field study show no contradictions. Especially on the following aspects, both studies come up with similar results:

- A general and encompassing methodology for developing team training systems is not available, but is very much wanted for. There are many activities in the field of team training; but these activities are not very structured, and the officers have no clear guidelines that can be of help.

- Conducting a task analysis is essential in specifying the instructional objectives. The instructional objectives are the basis of the actual development of a training system. With respect to team training, however, no proper task analyses are being conducted, resulting in an inadequate specification of the instructional objectives.
- The lack of explicit instructional objectives hinders the development of team training scenarios. A clear description of the to-be-trained knowledge and skills of the team members facilitates the design of various training scenarios. Guidelines concerning the application of several team training strategies, like crosstraining, could enhance the efficiency of the training programme.
- Measuring the performance of a team and providing feedback are crucial in team training. But these aspects of team training development are, at the same time, the most complicated ones. In only one case (the training of a two-person cockpit crew) a rather sophisticated measurement and feedback system has been developed. In all other cases, the issue of performance-measurement and feedback raised many questions, and no explicit answers.
- The specification of training simulators is more than merely copying the actual system or actual task environment into a learning environment. Rather than emphasizing the fidelity of these learning environments, the instructional features should be taken into account. Involving instructional developers and trainers in this process could improve the effectiveness of these training devices.
- Finally, assessing the quality of the training programme is hardly being done. This is an essential step, however, in determining whether the actual training need has been really met. Rather than merely waiting for feedback from the operational officers, instructional personnel could anticipate new developments and changing instructional needs. Guidelines could support also in this respect.

It is planned to select one or more training centres in order to attend and observe actual team training programmes. This step is an essential step, because the actual training practise could be somewhat different from the designer's and trainer's actual intentions (expressed in the interviews). To get a clear picture of a team training programme, observations will last for at least several days during a longer period of time (depending on the total length of the training programme). Ideally, the trained team should also be observed during a field exercise in the real operational environment.

The results of the literature and field study will be analysed and integrated into a (paper-based) prototype of a methodology for developing team training systems. This prototype methodology has to contain guidelines as concrete as possible. Further research will be aimed at developing the distinct guidelines comprising the methodology, and their empirical validation.

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APPENDIX Interview questions

Introduction

- To what extent does designing instruction for individual operators differ from designing instruction for teams?
- Is there a need for a methodology specifically aimed at developing team training?
- The literature is not very specific on this topic.
- The purpose of this field study is to gain insight into the way team training is being designed within the military. That is why I have chosen your organization.
- It could be that some questions are being asked that seem rather strange for you, and that can not be answered. That is alright. I am just interested in your organization's specific way of handling team training.

Background information

1 Could you tell something about your own professional background?
2 How many training developers and instructors/trainers are working in this organization?
3 How many teams (trainees) a year are being trained?
4 What kinds of training are being developed/executed?

Organization and premises

5 How is the organization of developing team training organized (one person, development team, other persons)? How is the coordination between these persons organized?
6 Is a team training program being executed by only one instructor/trainer, or more? If the latter case is true, how is the coordination between the instructors being organized?
7 What (general) principles for instructional systems development are being applied?
8 Is the development process being supported by some methodology handbook, prescriptions, and/or software tools?

Analysis

9 How is the training need established?
10 How are team tasks being analysed?
11 How are instructional objectives being derived?

Design and execution

12 How is the structure of the training program (learning trajectory) established? This relates to the structure of the team training on the one hand, and the relationship between team training, individualized training and the operational practice on the other hand.
13 How are training scenarios being developed?
14 Are there certain team characteristics which influence how to instruct a team (e.g. the way of communication, kind of leadership, mutual personal relations)? If so, which are these, how are these identified, and how does this adapt the instruction?
15 To what extend is instruction being differentiated towards the individual team members, and how is this accomplished?
16 How is checked for the involvement of all team members during the execution of the training program?
17 How do you monitor the learning process of the team and the individual team members?
18 How do you decide when to intervene in the training process?

Performance measurement and feedback

19 Is the performance of the team assessed during the training? If so, at what moments?
20 How is the team performance being measured? To what extend is there a distinction between the process and product of the team performance?
21 Is the individual team member's performance being measured? To what extend is there a distinction between the process and product of the individual team member's performance?
22 Is feedback being provided towards the team as a whole, towards the individual team members, or both to the team and its individual members?
23 How is the feedback being provided?
24 Is a debrief at the end of a team training being organized? If so, how is this done?

Instructional activities and training devices

25 Which instructional activities are being employed during the team training?
26 Which training devices are being applied during the team training?
27 How are the requirements for (technologically advanced) training devices being specified? Who's responsibility is this?

Evaluation and maintenance

28 Is the effectiveness of the training program established? If so, how is this being done?
29 Is there a feedback loop from the operational practice back to the training program? If so, how does this work?
30 Are sufficient resources available in order to maintain training programs, scenarios and training devices?
31 In what way are changing instructional needs being encountered?

Concluding remarks

32 Are there specific aspects (bottlenecks, positive points) regarding the development of team training systems that have not been discussed yet?
33 Do you have any remarks and/or questions with respect to this interview?

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14. SUPPLEMENTARY NOTES

15. ABSTRACT (MAXIMUM 200 WORDS (1044 BYTES))

Despite the acknowledgment of the importance of team performance and team training, relatively few endeavours have been undertaken to actually train teams in a systematic way. A possible explanation could be that there is not yet a methodology to guide the instructional developers and trainers in designing, executing, and evaluating team training systems. The research question to be answered in this study is which guidelines should be included in a methodology supporting the systematic development of team training systems. In order to give an answer to this question the following strategy is proposed: conduct a literature study, conduct a field study, develop a prototype of the methodology, conduct an expert-evaluation, test the prototype in various experiments, and apply the methodology in real-life cases. This strategy is discussed extensively. The results of the literature study (Van Berlo, 1996a) and the field study (Van Berlo, 1997b) are briefly reviewed.

16. DESCRIPTORS

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In zowel militaire als civiele organisaties worden veel taken eerder door teams dan door individuele functionarissen uitgevoerd. Ondanks het belang dat wordt gehecht aan team optreden worden relatief weinig systematische inspanningen geleverd met betrekking tot de training van teams. Een mogelijke verklaring hiervoor is dat er geen systematiek is die het ontwikkelen, uitvoeren en evalueren van team trainingen ondersteunt. De meeste systematieken en richtlijnen zijn primair gericht op het opleiden van de individuele functionaris. Het gevolg hiervan is dat opleidingsontwikkelaars van team trainingen beperkt ondersteund worden omdat de bestaande (op de individuele functionaris gerichte) systematieken onvoldoende de kenmerken van teams en team optreden verdisconteren. Dit heeft tot gevolg dat van bestaande leermiddelen die zijn ontworpen met als doel het trainen van team vaardigheden, het vaak niet duidelijk is welke onderwijskundige principes op welke manier toegepast moeten worden.

Team training wordt soms ten onrechte verward met team building of coöperatief leren. Hoewel er overeenkomsten zijn, zijn er ook duidelijke verschillen. Een belangrijk onderscheid tussen team training en team building is, dat team building meestal niet gericht is op de specifieke taken die een team in een bepaalde context moet uitvoeren, terwijl team training hier wel expliciet aandacht aan besteedt: er worden dus hele andere kennis en vaardigheden behandeld. In coöperatieve (onderwijs)-leersituaties is eerder sprake van een groep van individuen, dan van een team: het leren is primair gericht op het verwerven van vaardigheden door het individu (bv. rekenen), en minder nadrukkelijk op het verwerven van 'sociale' vaardigheden om als groep beter te functioneren. Het leren gebeurt in de context van een groep omdat verondersteld wordt dat dit bevorderlijk is voor het eindresultaat.

De onderzoeksvraag van deze studie is uit welke richtlijnen een opleidingsontwikkelsystematiek voor team trainingen zou moeten bestaan. Om deze vraag te kunnen beantwoorden wordt de volgende strategie voorgesteld: uitvoeren van een literatuurstudie, uitvoeren van een veldstudie, ontwerpen van een prototype, uitvoeren van een expert-evaluatie, uitvoeren van diverse experimenten om het prototype te testen, en toepassen van de systematiek in een of meerdere praktijksituaties. Deze strategie wordt uitgebreid toegelicht. De resultaten van de literatuurstudie (Van Berlo, 1996a) en de veldstudie (Van Berlo, 1997b) worden kort besproken.

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